

### **Abstract**

An apparatus for making a crystal pre-melt includes a hermetically-sealed muffle furnace made of a non-porous refractory material, at least one port for entry and exit of gaseous substance within the muffle furnace, a temperature-controlled zone defined inside the muffle furnace, and a crucible for holding crystal raw material in solid or molten form inside the muffle furnace. The crystal pre-melt is made by disposing crystal raw material in loose powder, pressed powder, granular, or densified form in the temperature-controlled zone, heating the temperature-controlled zone to a treatment temperature that enables reaction between a fluorinating agent and oxides in the crystal raw material, reacting the fluorinating agent with the crystal raw material to produce volatile gases, removing the volatile gases from the muffle furnace, heating the crystal raw material to form a melt, and solidifying the melt to form the crystal pre-melt.